nominet

Fun with IPv4 Heatmaps

Roy Arends

Nominet UK

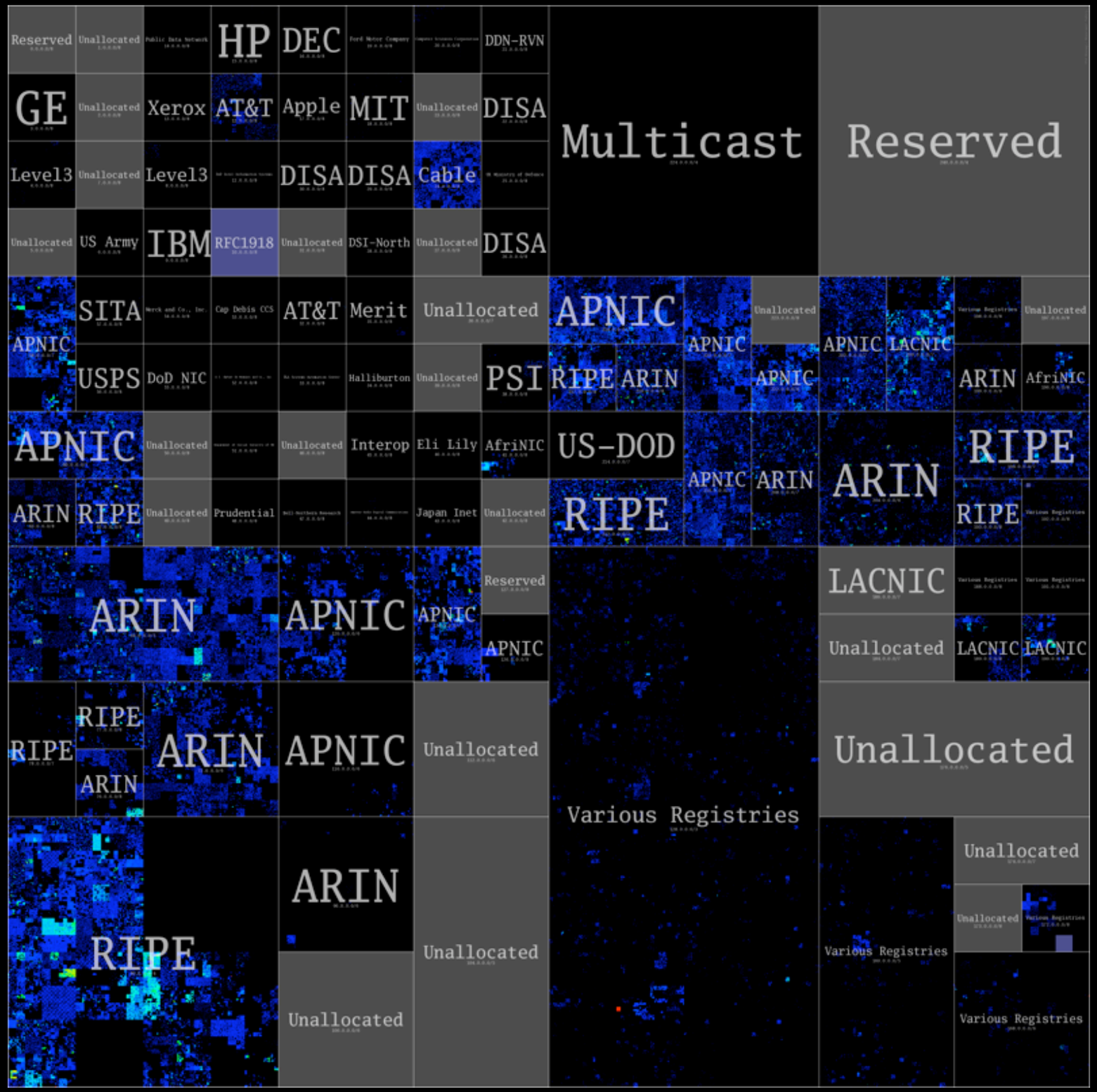
Open Resolver Addresses

Mapped in Hilbert Order

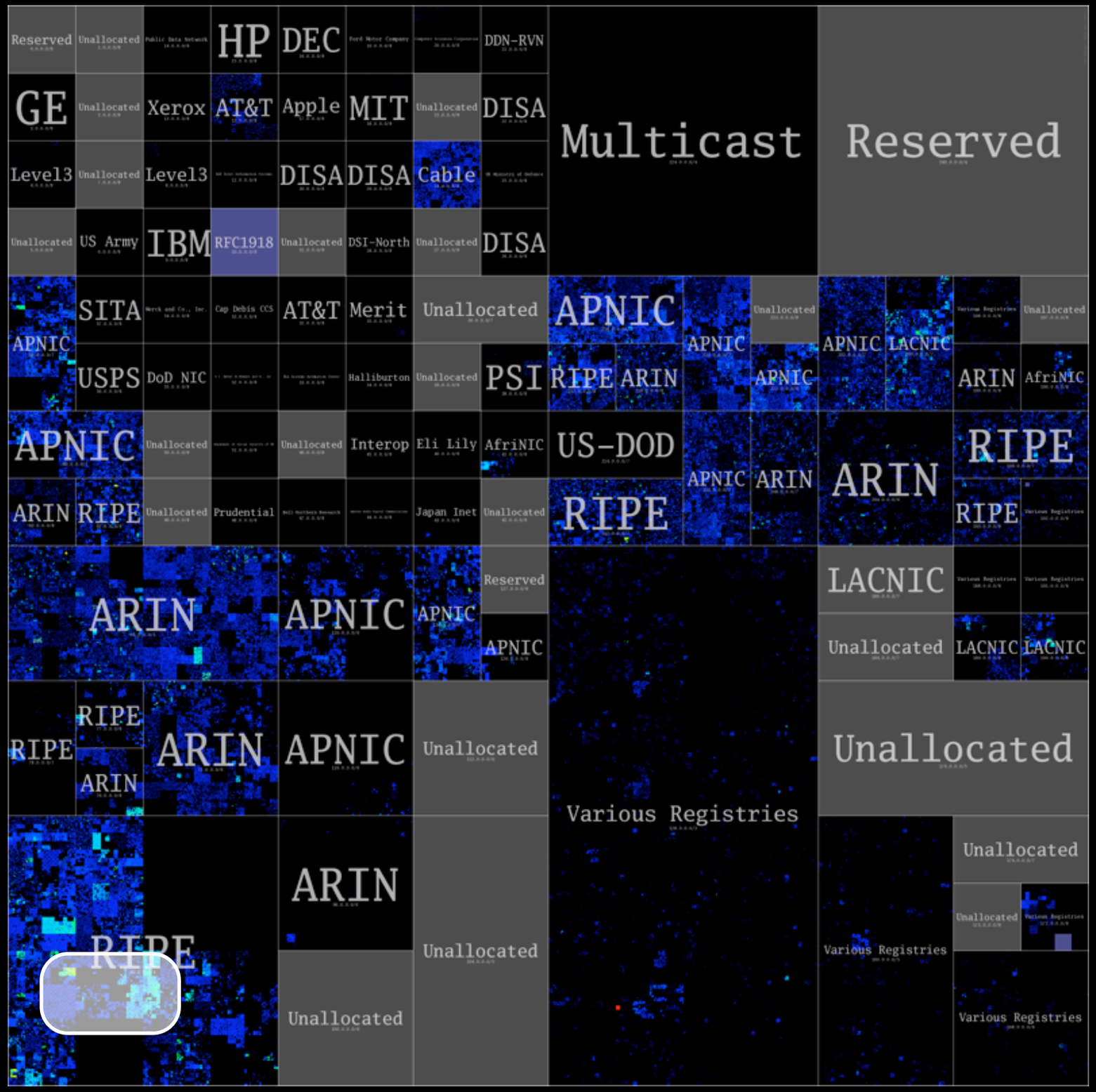
Colored by /24 saturation

code: Duane Wessels

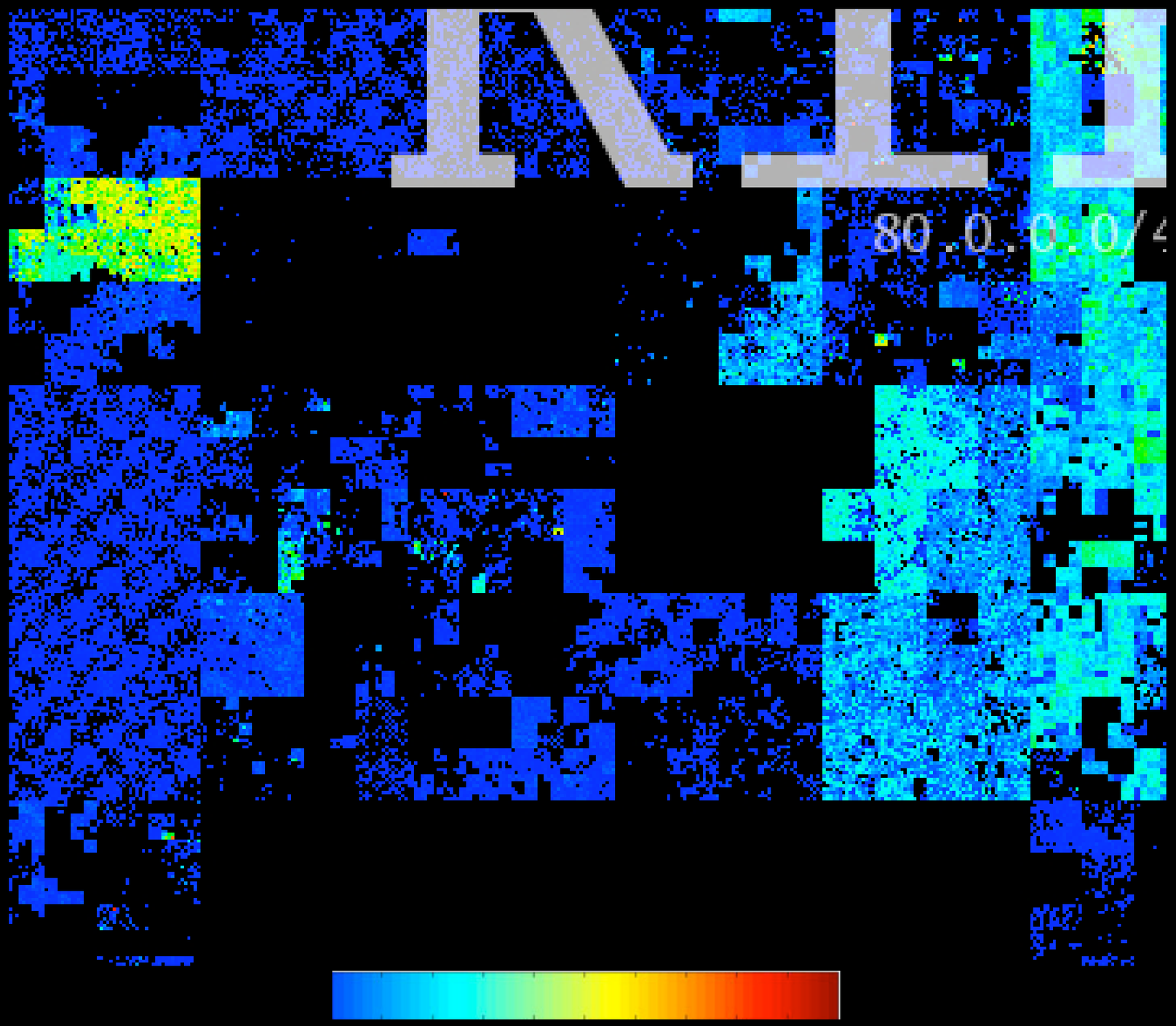
data: John Kristoff



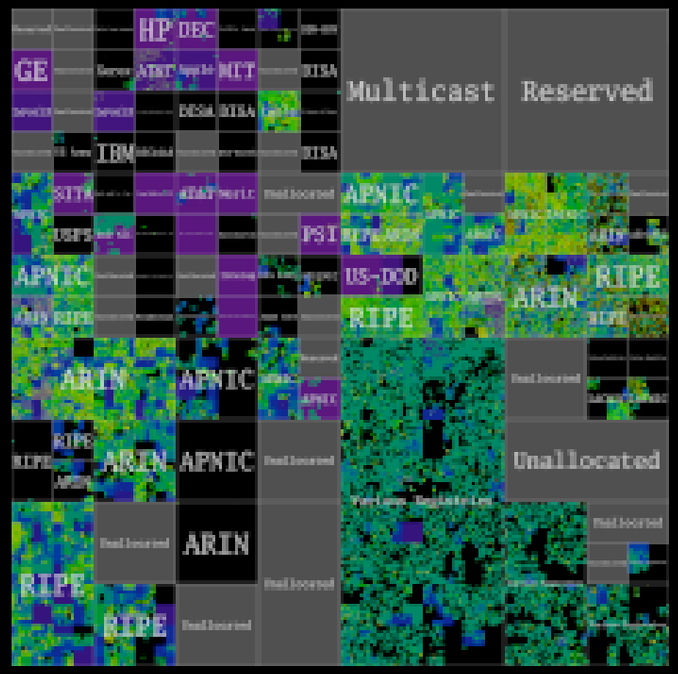
More than 16,000,000 open resolvers
during a sweep of the IPv4 address space.



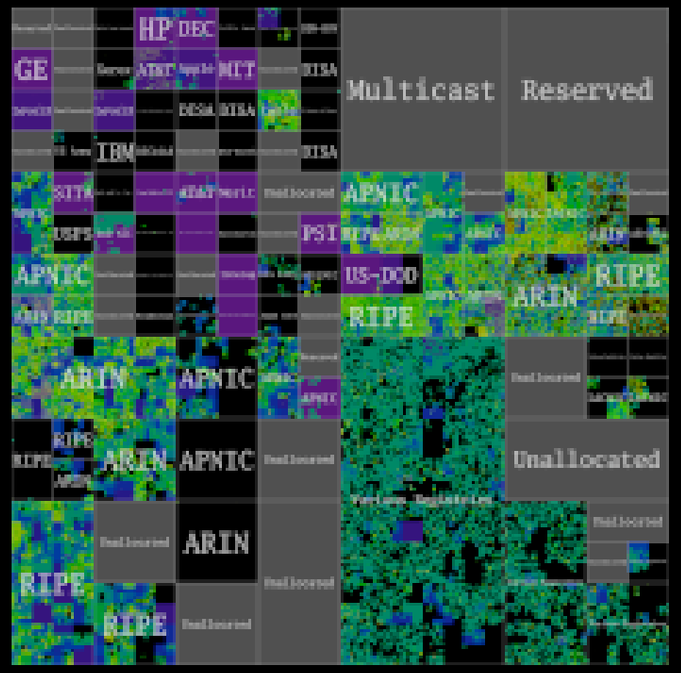
More than 16,000,000 open resolvers
during a sweep of the IPv4 address space.



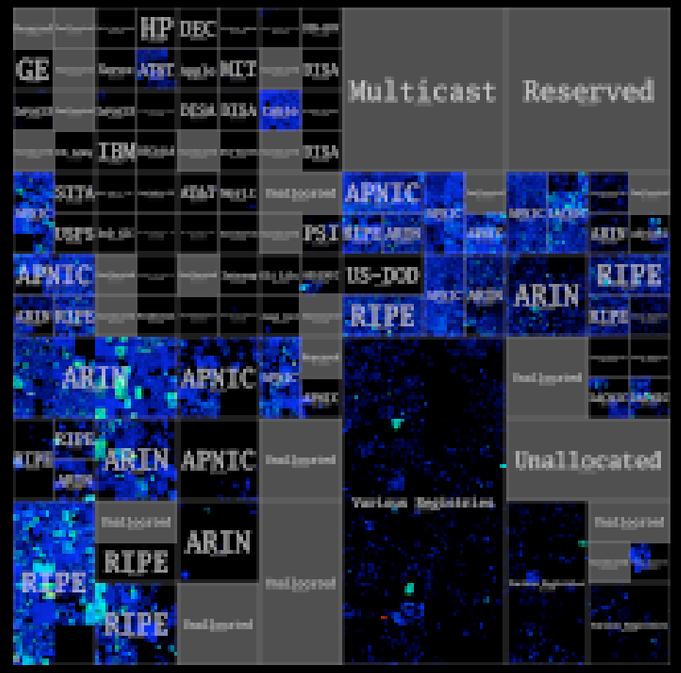
detail of 80.0.0.0/4
One /24 network per pixel, colored by saturation.



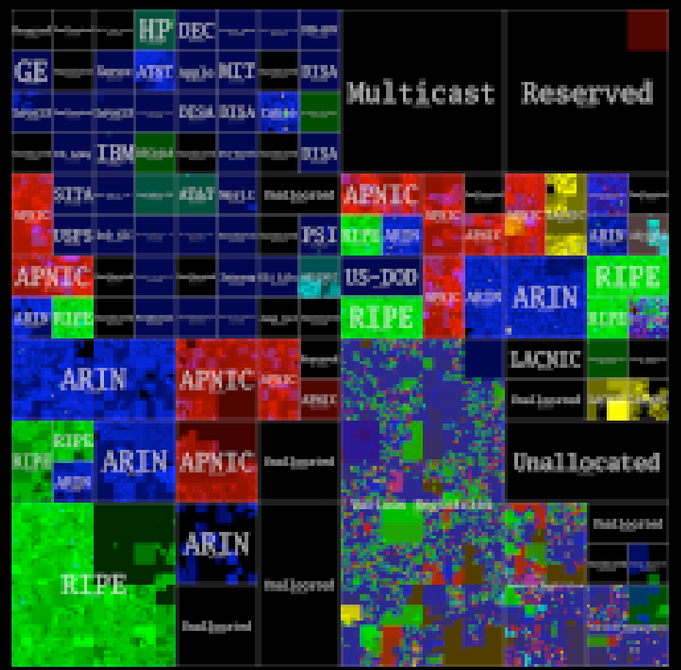
BGP Routeviews



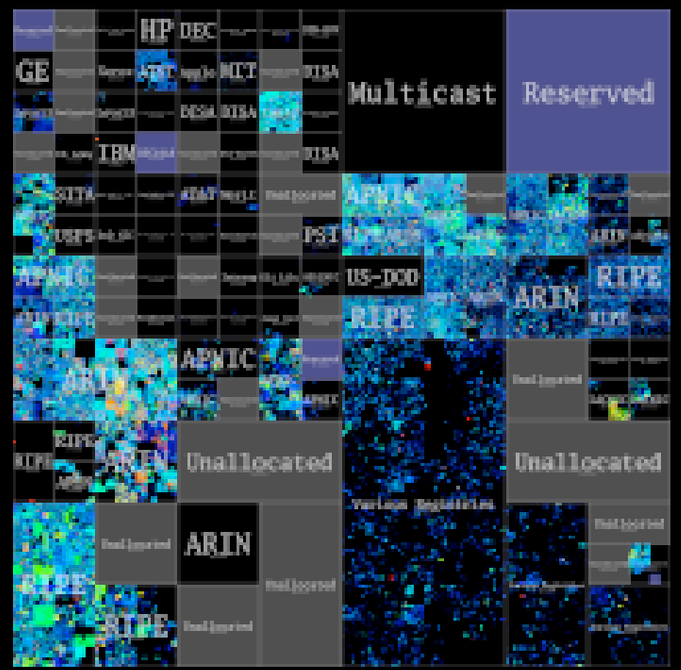
BGP Routeviews



Open Resolvers



RIR whois



Census

Inspired by XKCD

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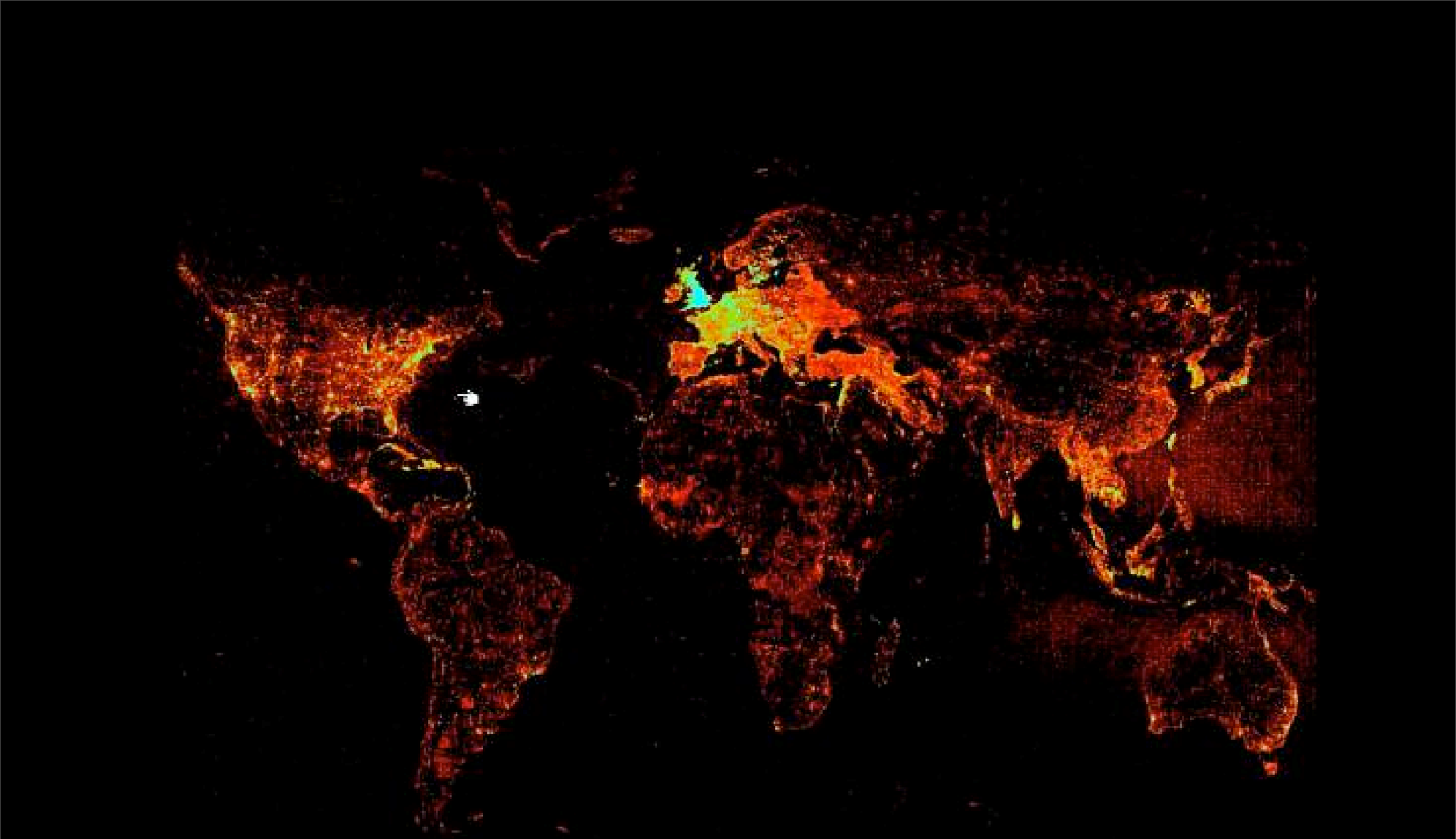
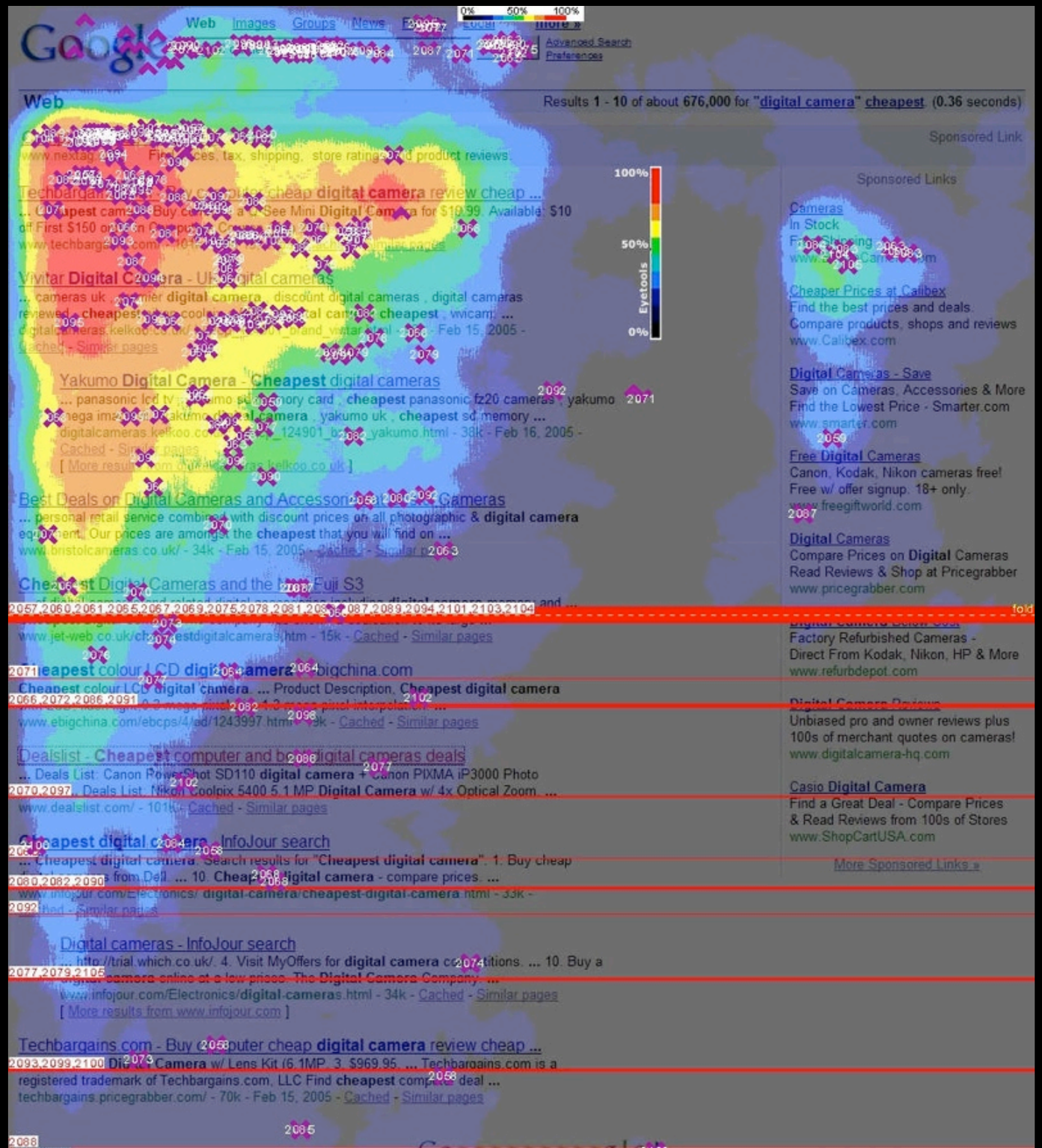
Examples of Heatmaps



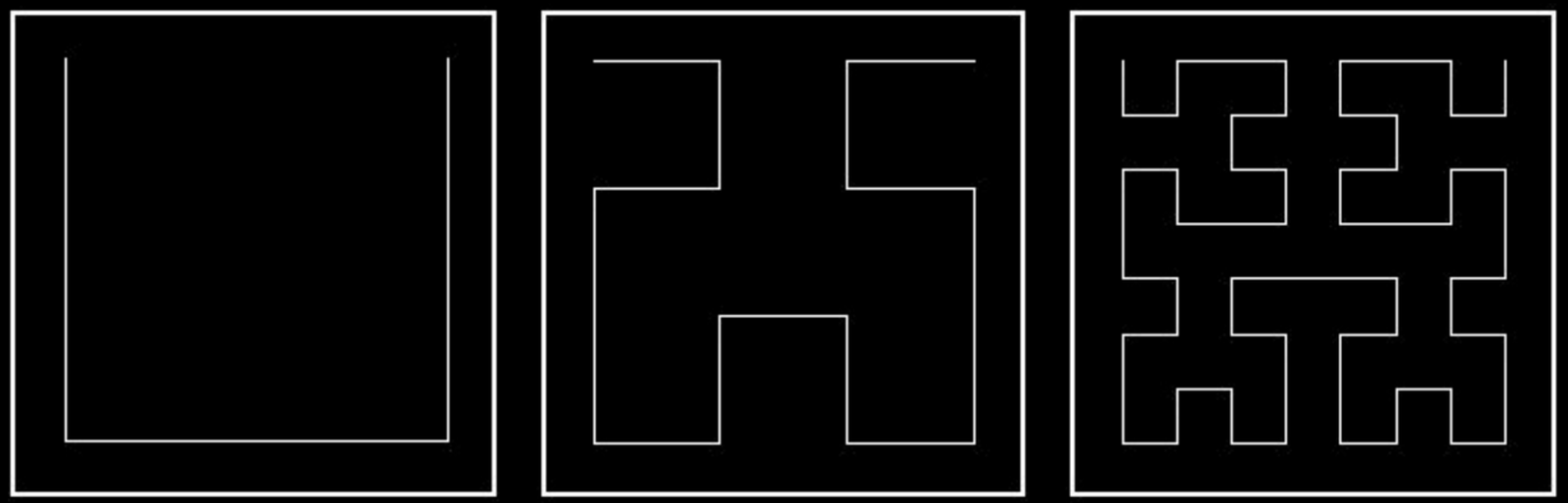
Ed Parsons “the Cathedral and the GPS”
footprints of google’s KML/GeoRSS database



Eyetools heatmaps
Where do viewers look and click

GeoIQ
Heatmap layer for Google maps

IPv4 Heatmap in Hilbert Order.



Hilbert curves, order 1 to 6
Direction changes with every order

1	2	15	16
4	3	14	13
5	8	9	12
6	7	10	11

16 points on a 2nd order hilbert curve

Using Hilbert Curves:
Consecutive netblocks can be grouped together.

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However

In networking, only those consecutive netblocks
that share the same prefix need to be grouped together.

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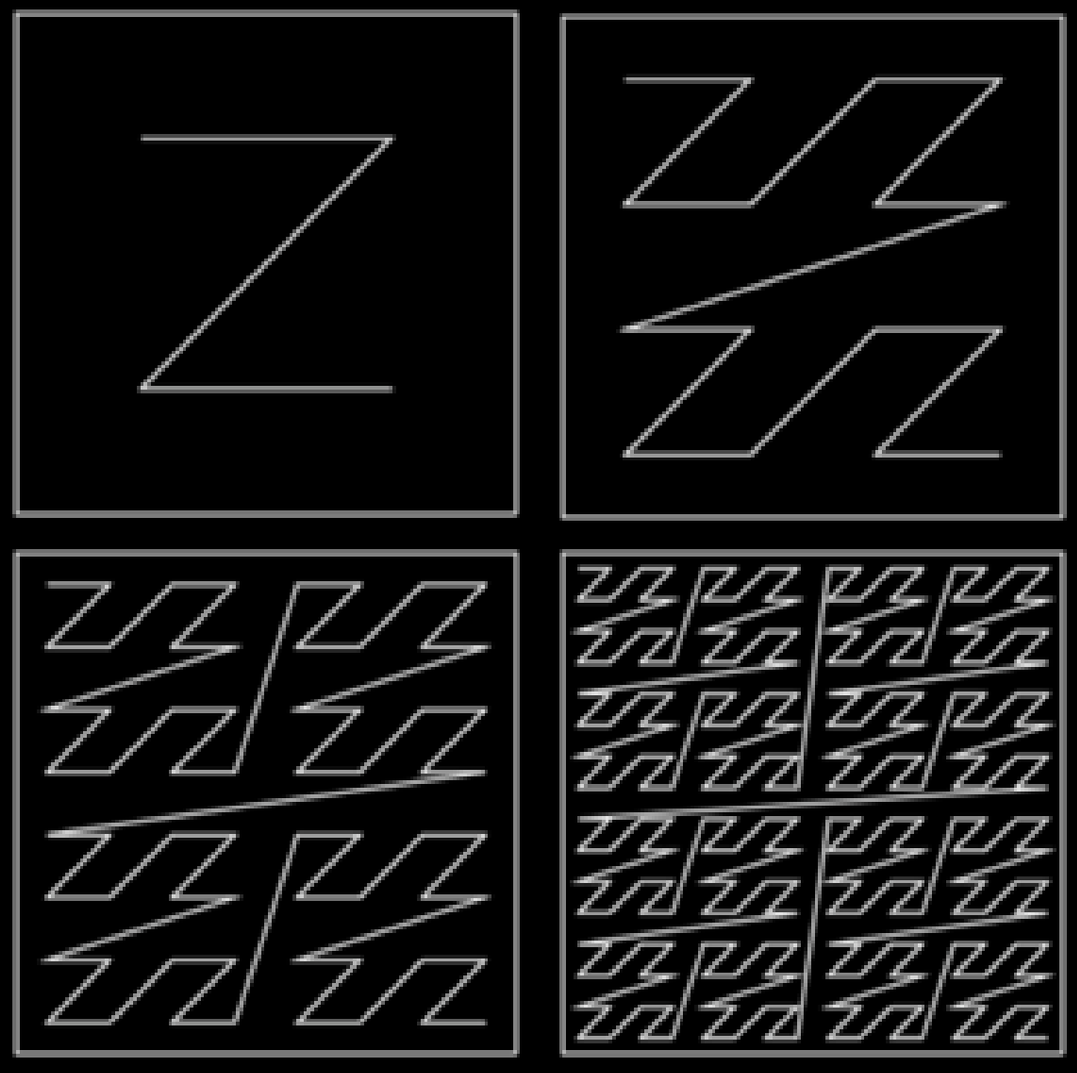
In networking, only those consecutive netblocks
that share the same prefix need to be grouped together.

127 / 8 + 128 / 8 != 127 / 7

Using Morton Curves:

consecutive netblocks that share the prefix
can be grouped as one netblock.

Which is tailored to our needs.



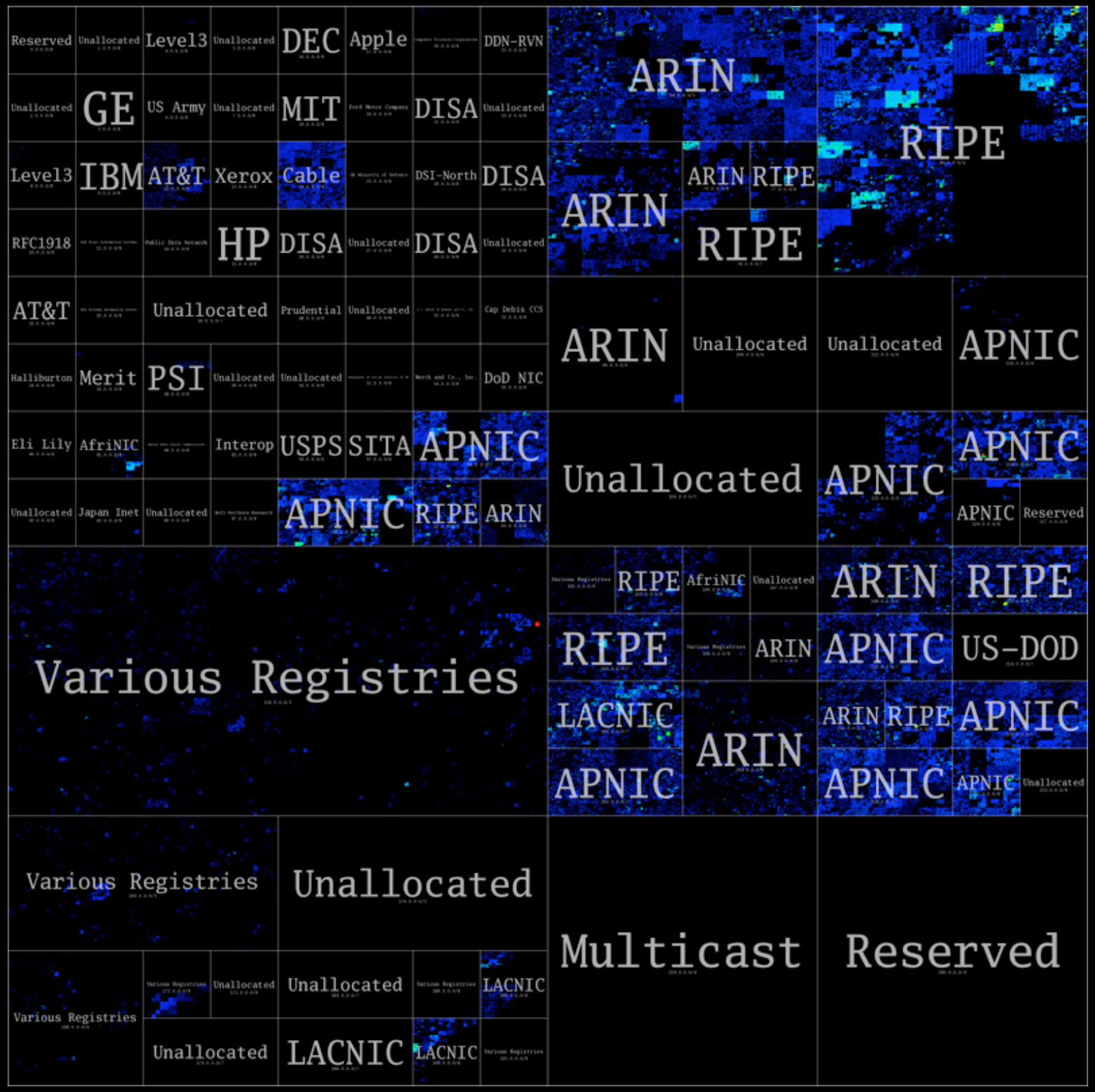
Morton curves, order 1 to 4
Direction is the same with every order

1	2	5	6
3	4	7	8

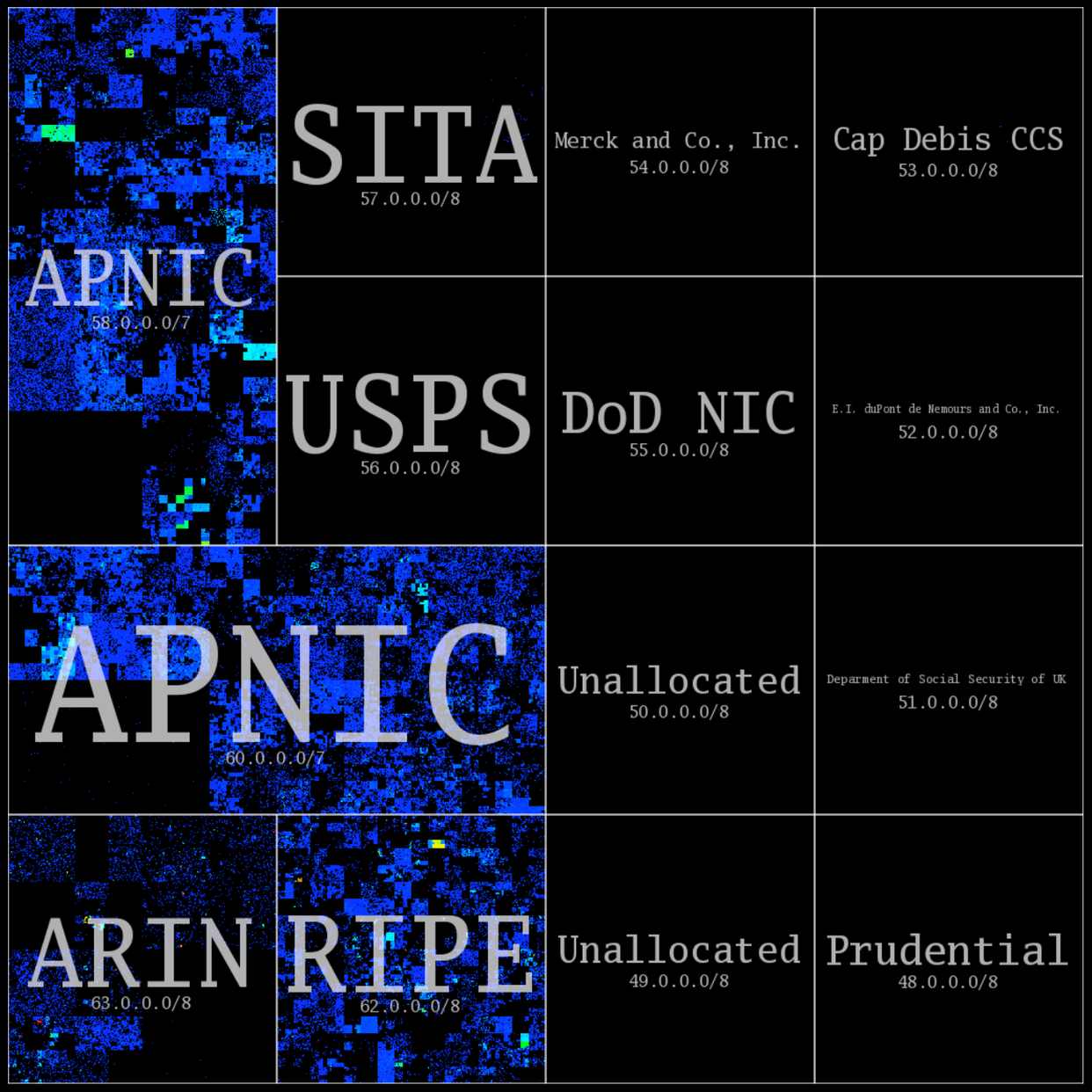
9	10	13	14
11	12	15	16

16 points on 2nd order Morton curve

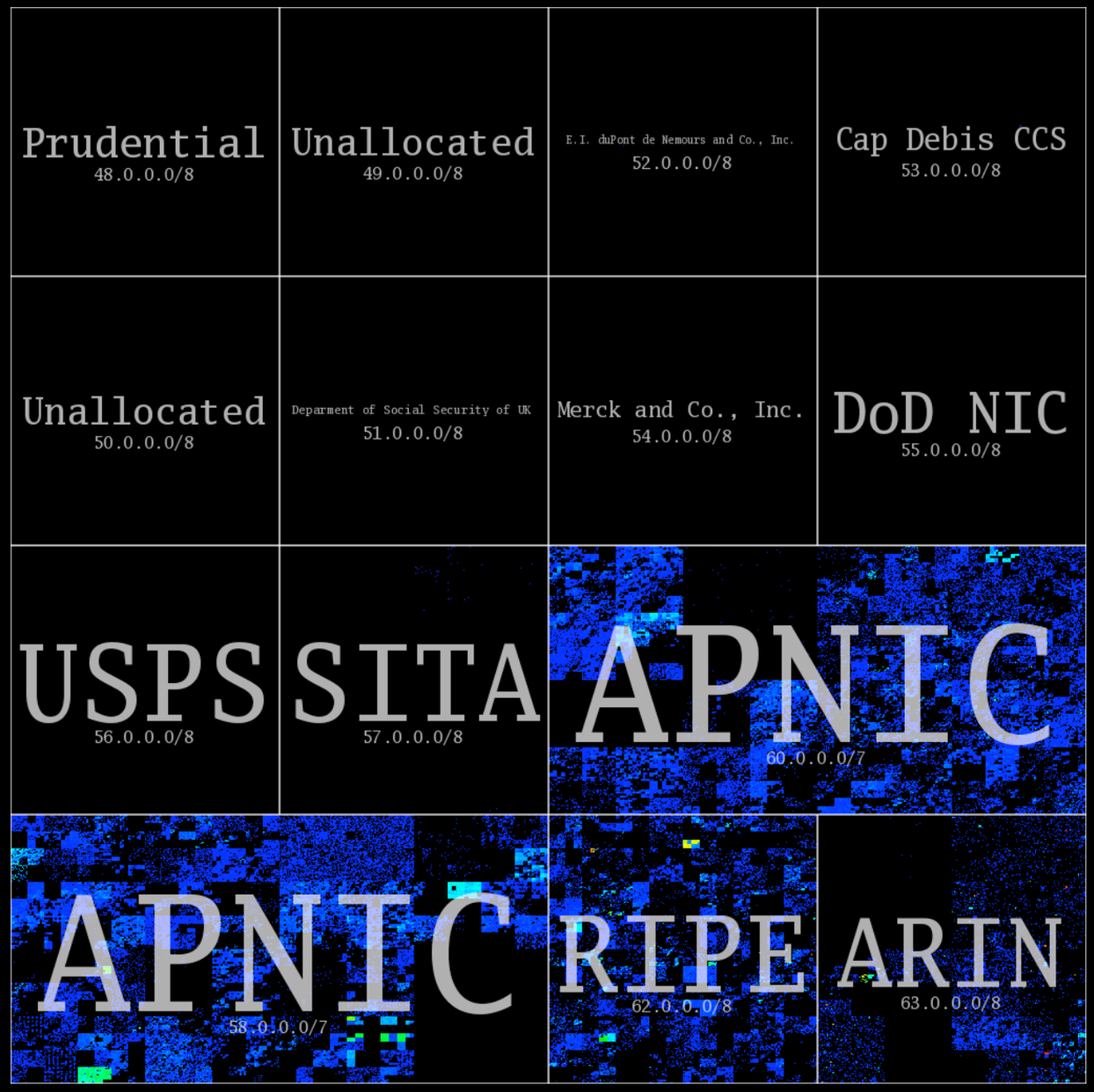
IPv4 Heatmap in Hilbert Order.



IPv4 Heatmap in Morton Order.



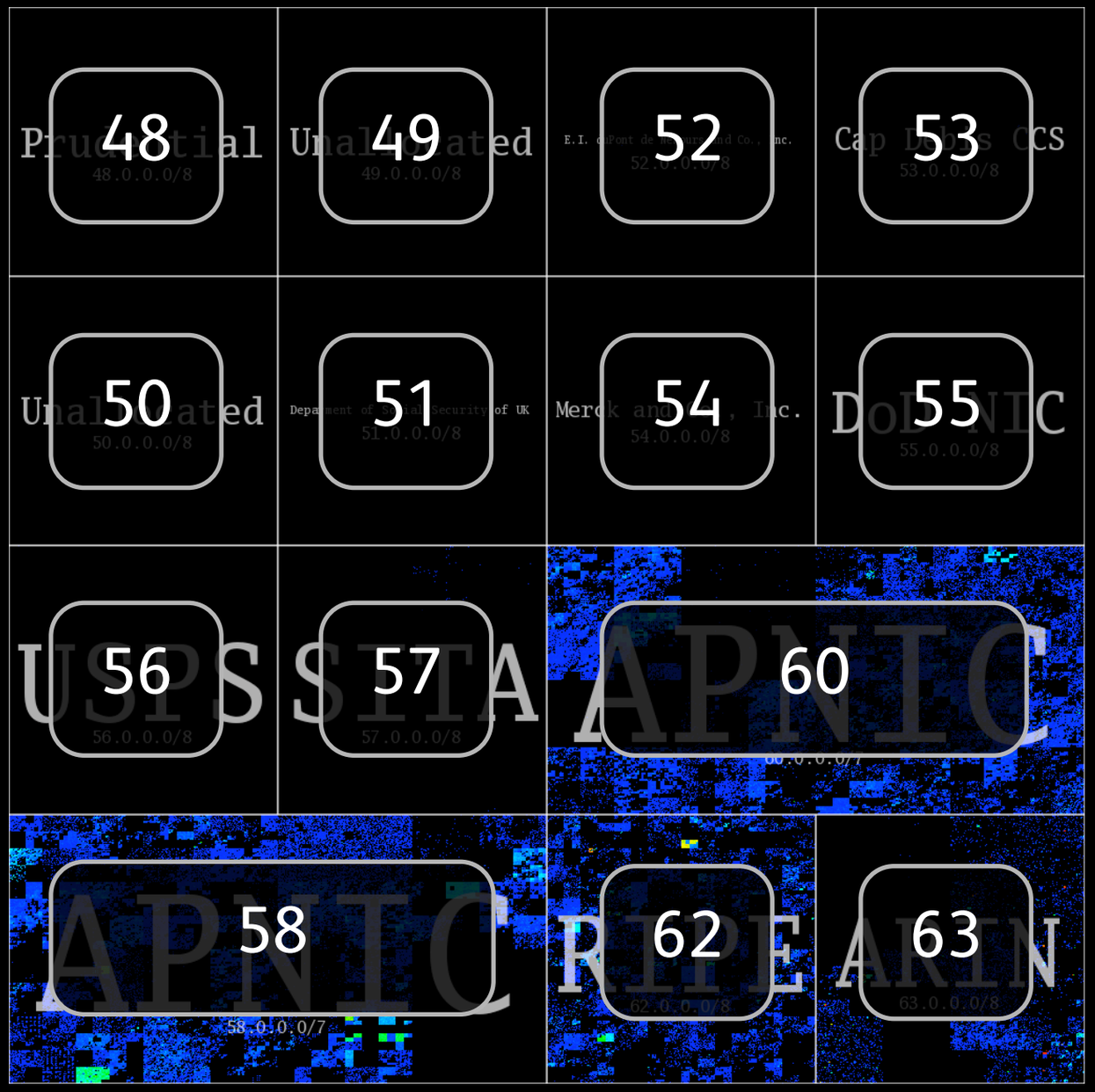
Hilbert



Morton

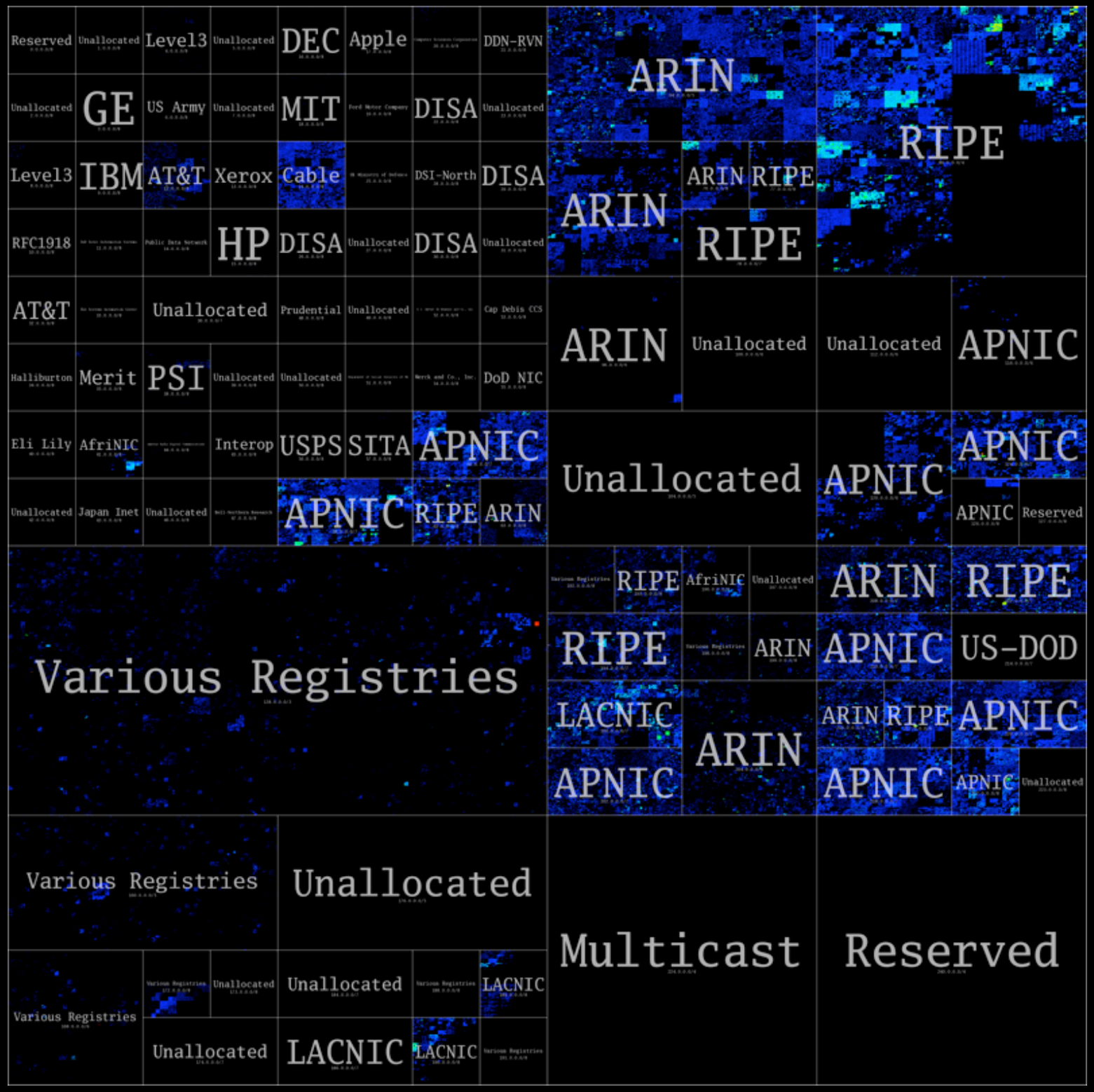
Detail of 48/4

Hilbert

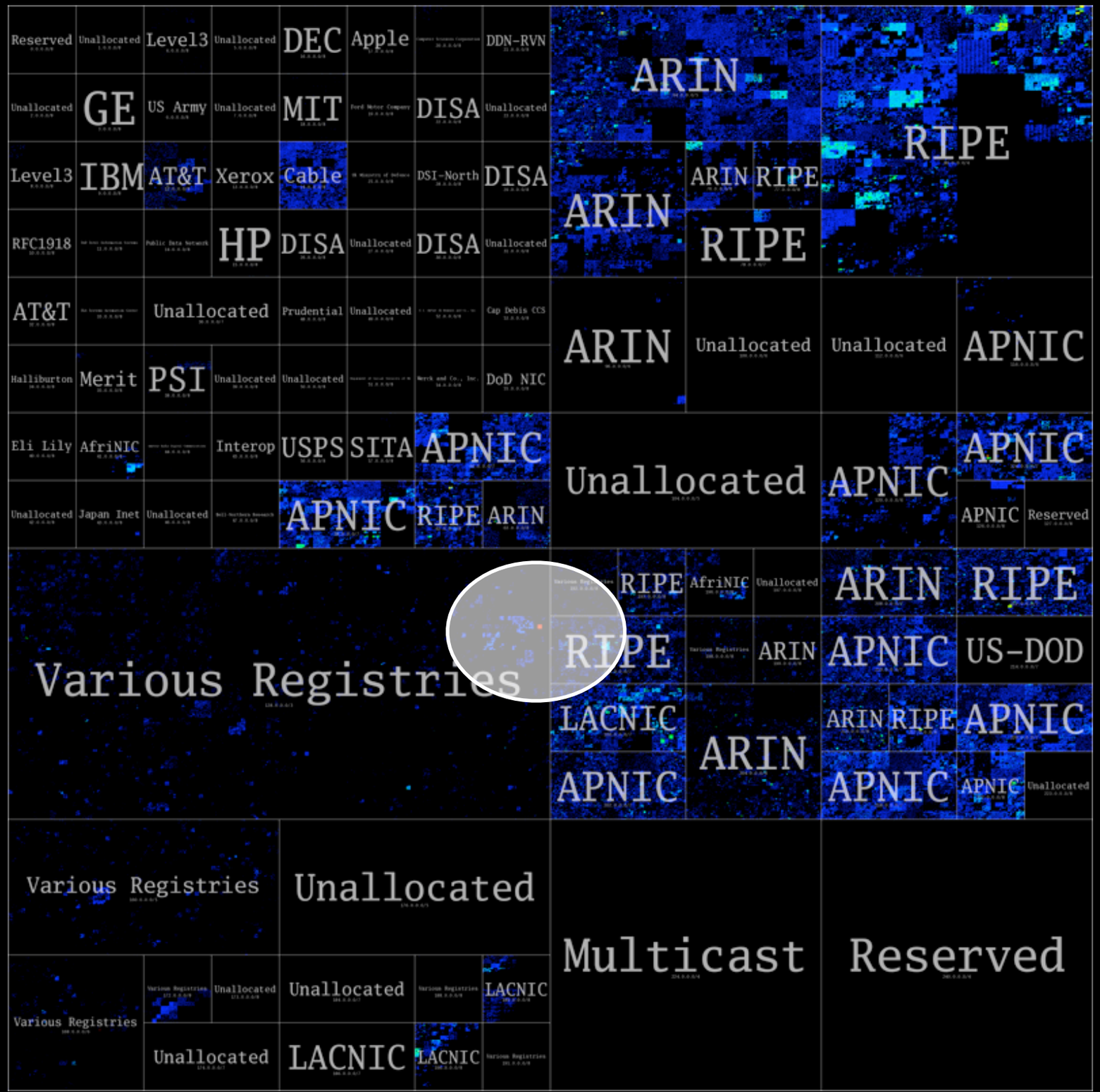


Morton

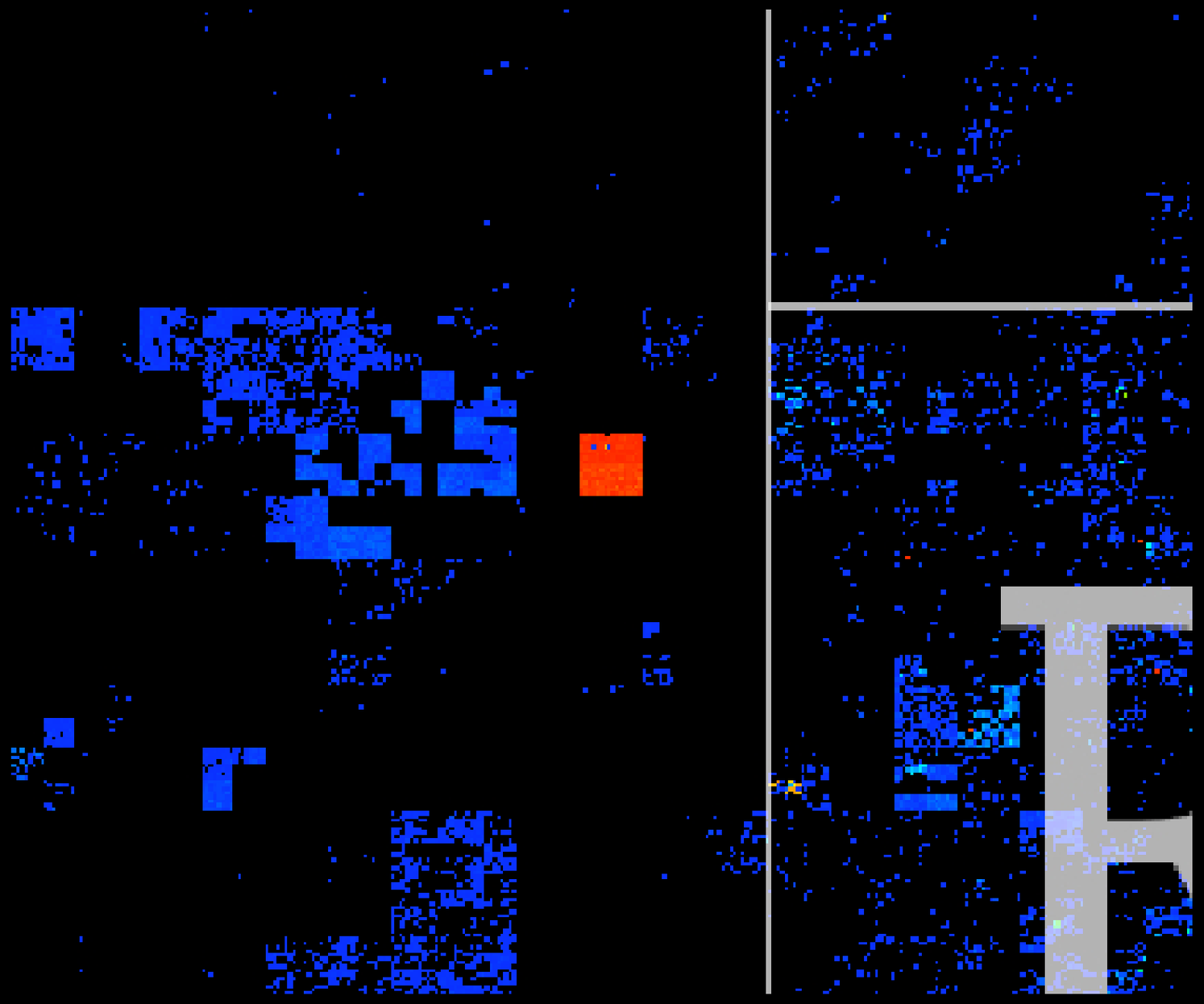
Detail of 48/4



IPv4 Heatmap in Morton Order.

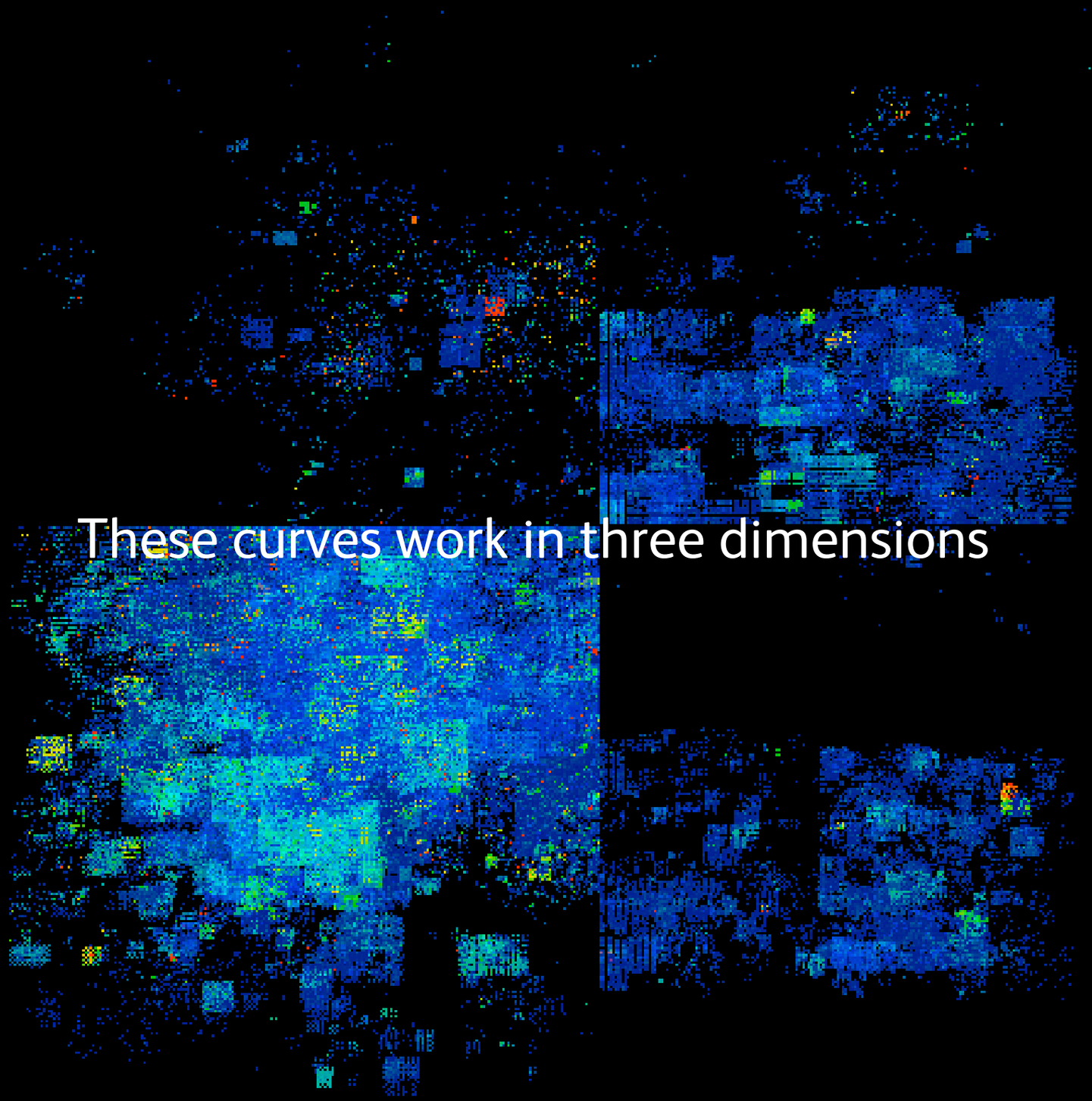


IPv4 Heatmap in Morton Order.
Notice the very red spot.

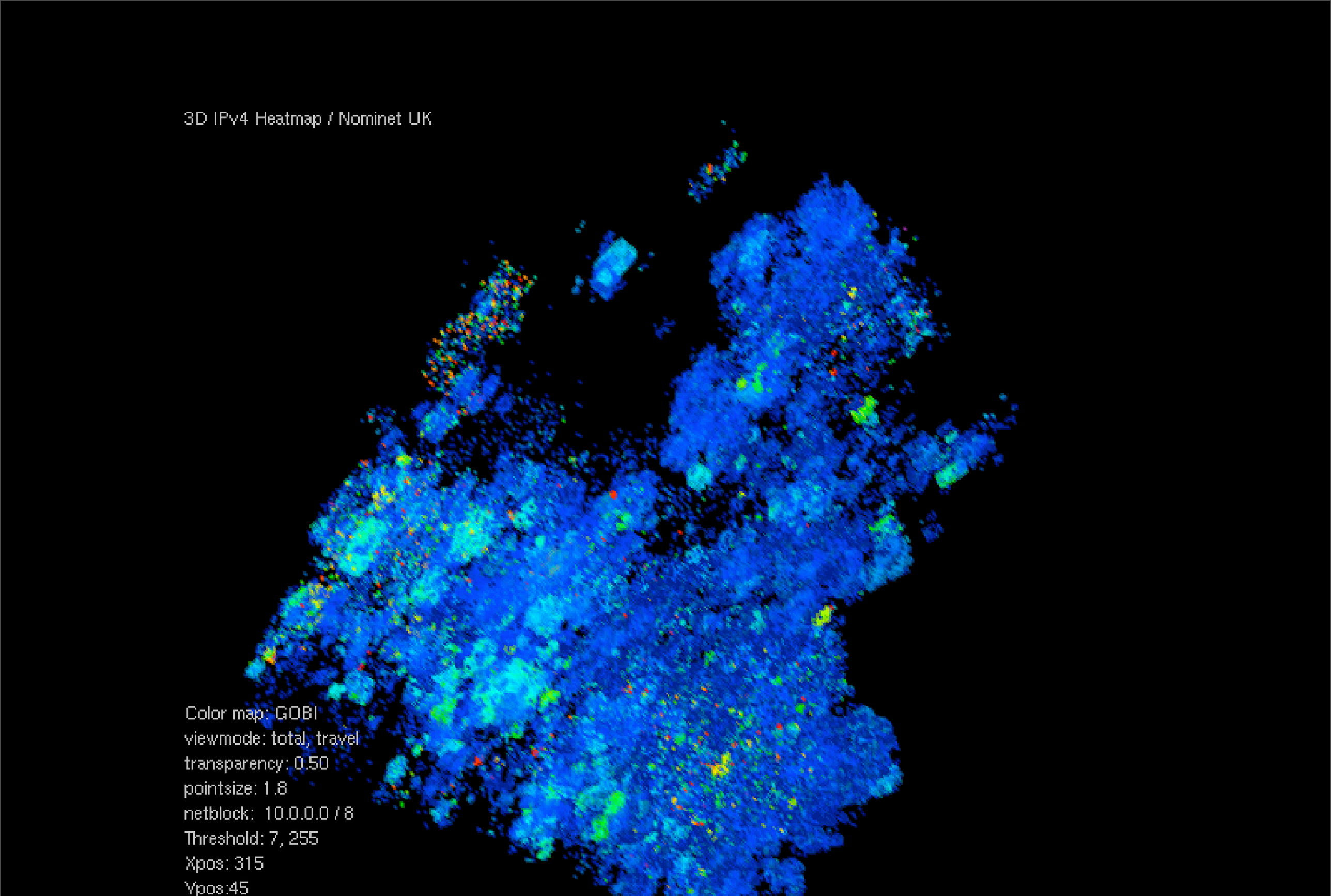


This is a /16 network

These curves work in three dimensions

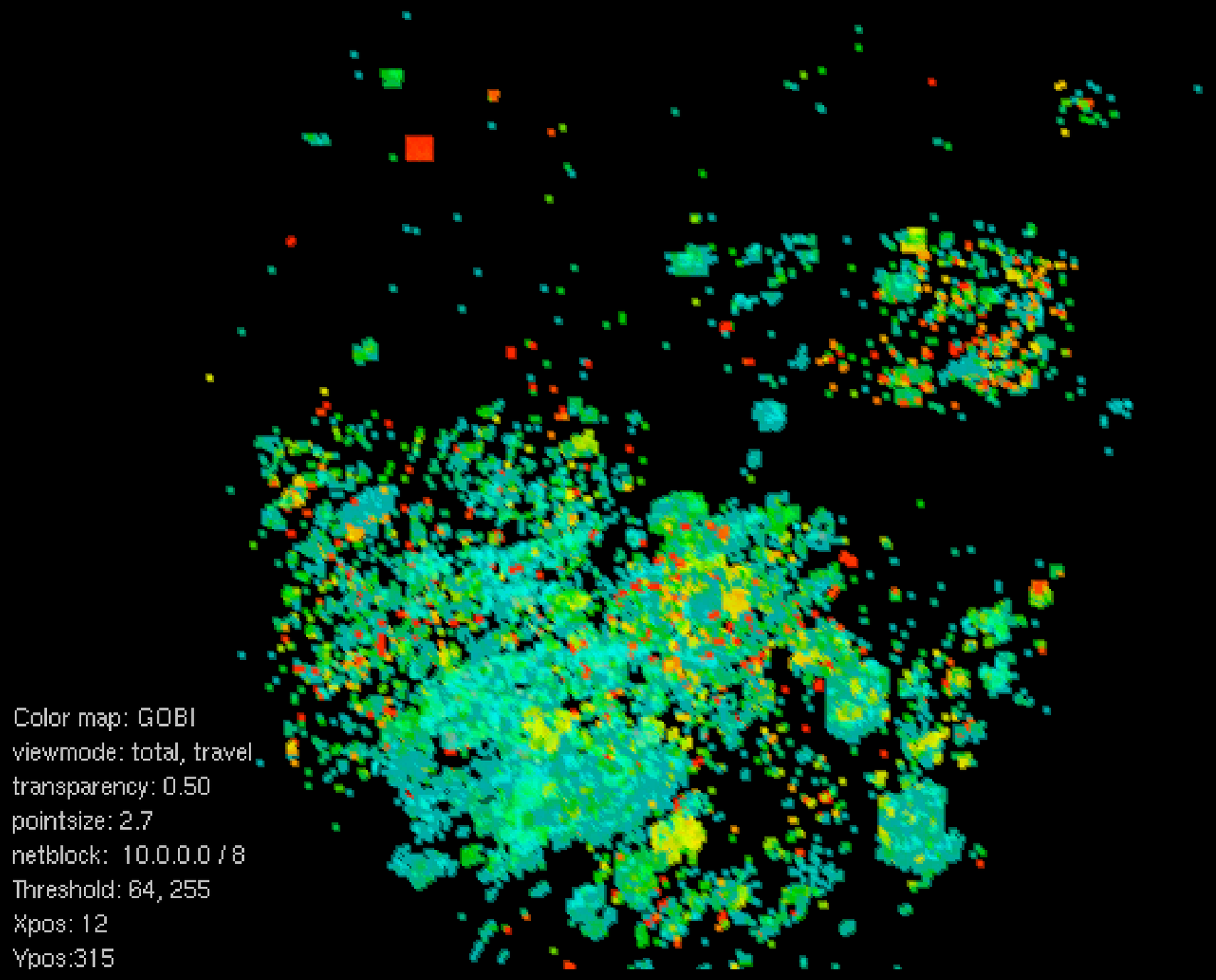

These curves work in three dimensions

3D IPv4 Heatmap / Nominet UK



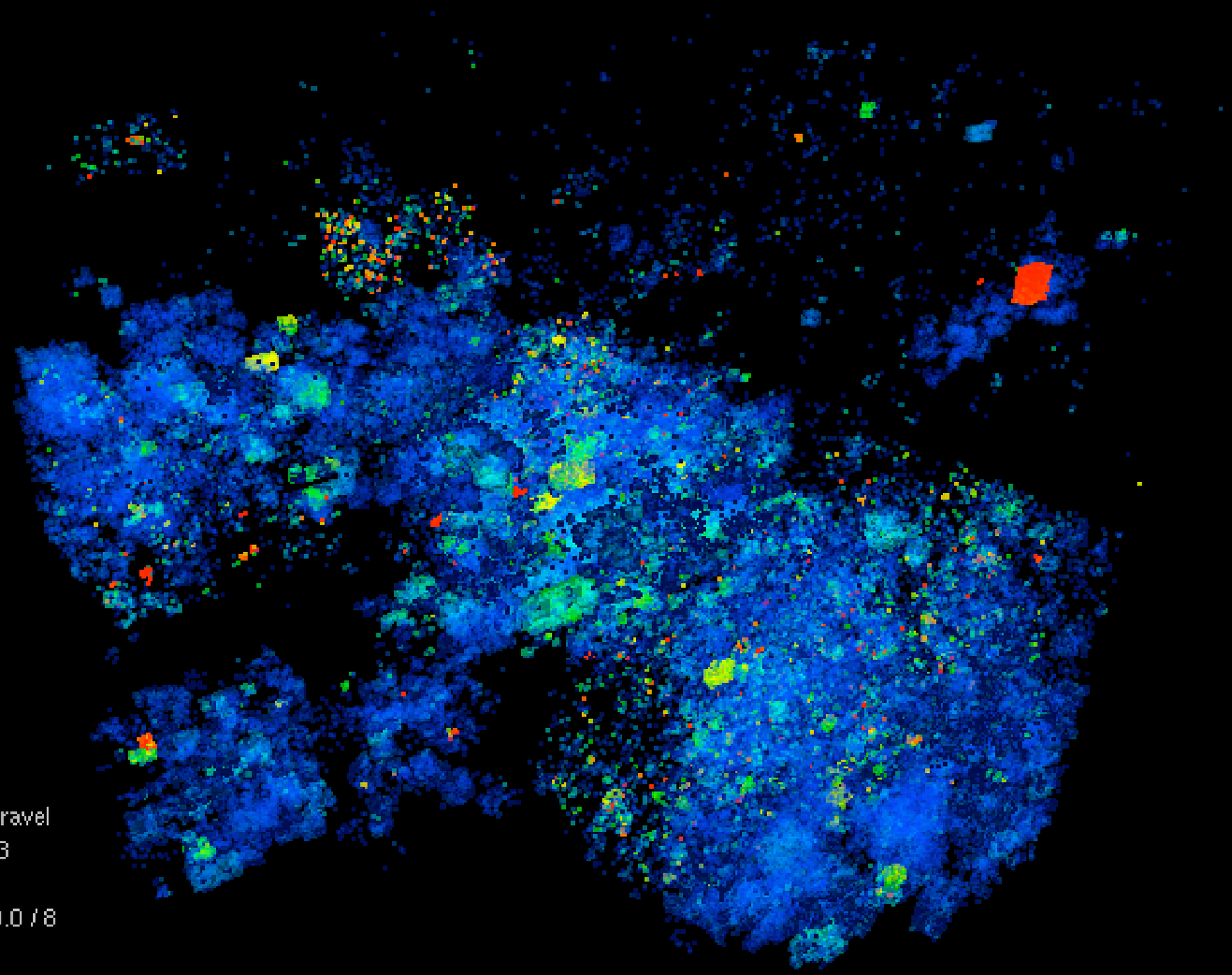
Color map: GOBI
viewmode: total, travel
transparency: 0.50
pointsize: 1.8
netblock: 10.0.0.0 / 8
Threshold: 7, 255
Xpos: 315
Ypos:45

3D IPv4 Heatmap / Nominet UK



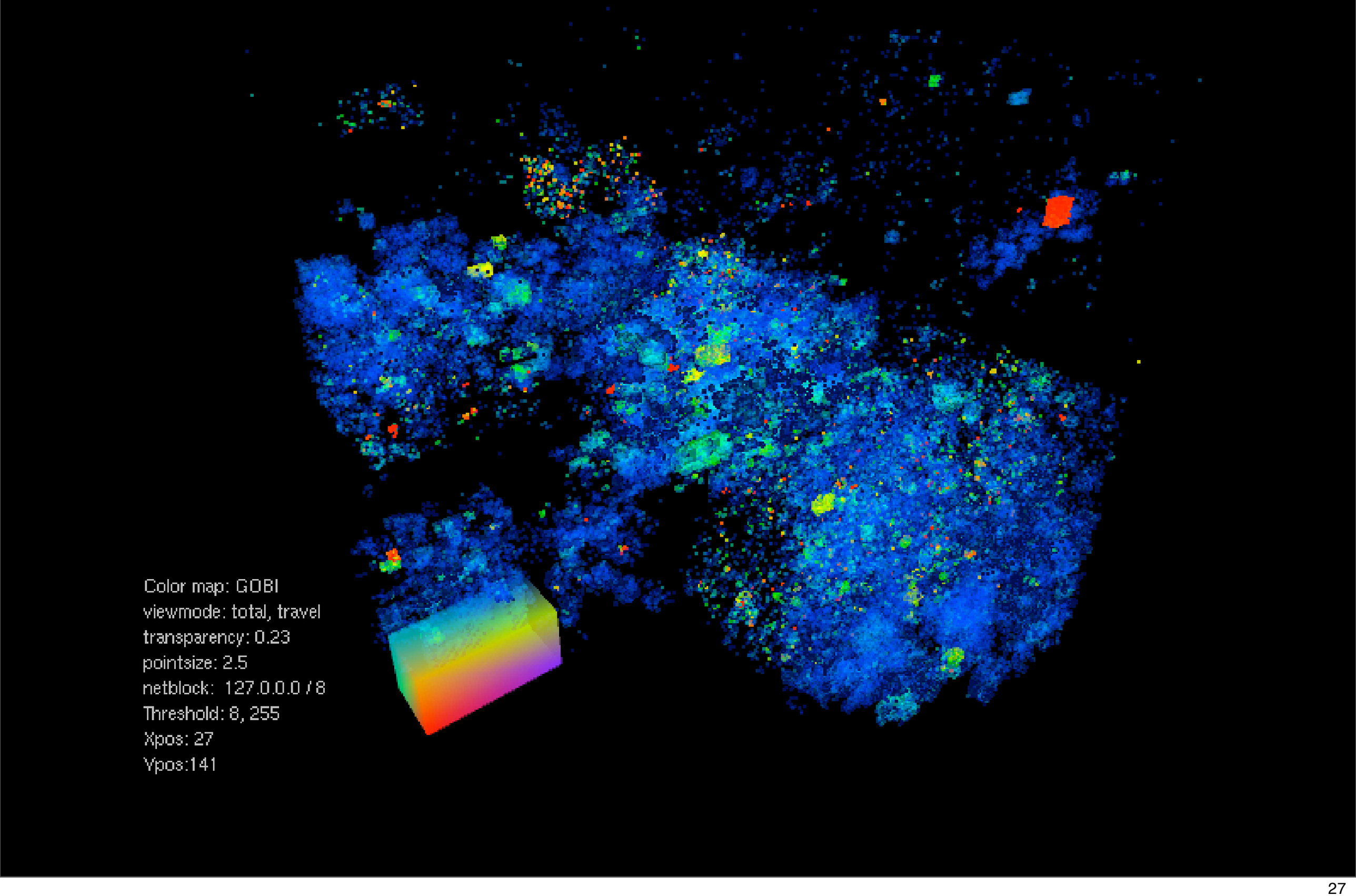
Color map: GOBI
viewmode: total, travel
transparency: 0.50
pointsize: 2.7
netblock: 10.0.0.0 / 8
Threshold: 64, 255
Xpos: 12
Ypos:315

3D IPv4 Heatmap / Nominet UK



Color map: GOBI
viewmode: total, travel
transparency: 0.23
pointsize: 2.5
netblock: 127.0.0.0 / 8
Threshold: 8, 255
Xpos: 27
Ypos:141

3D IPv4 Heatmap / Nominet UK



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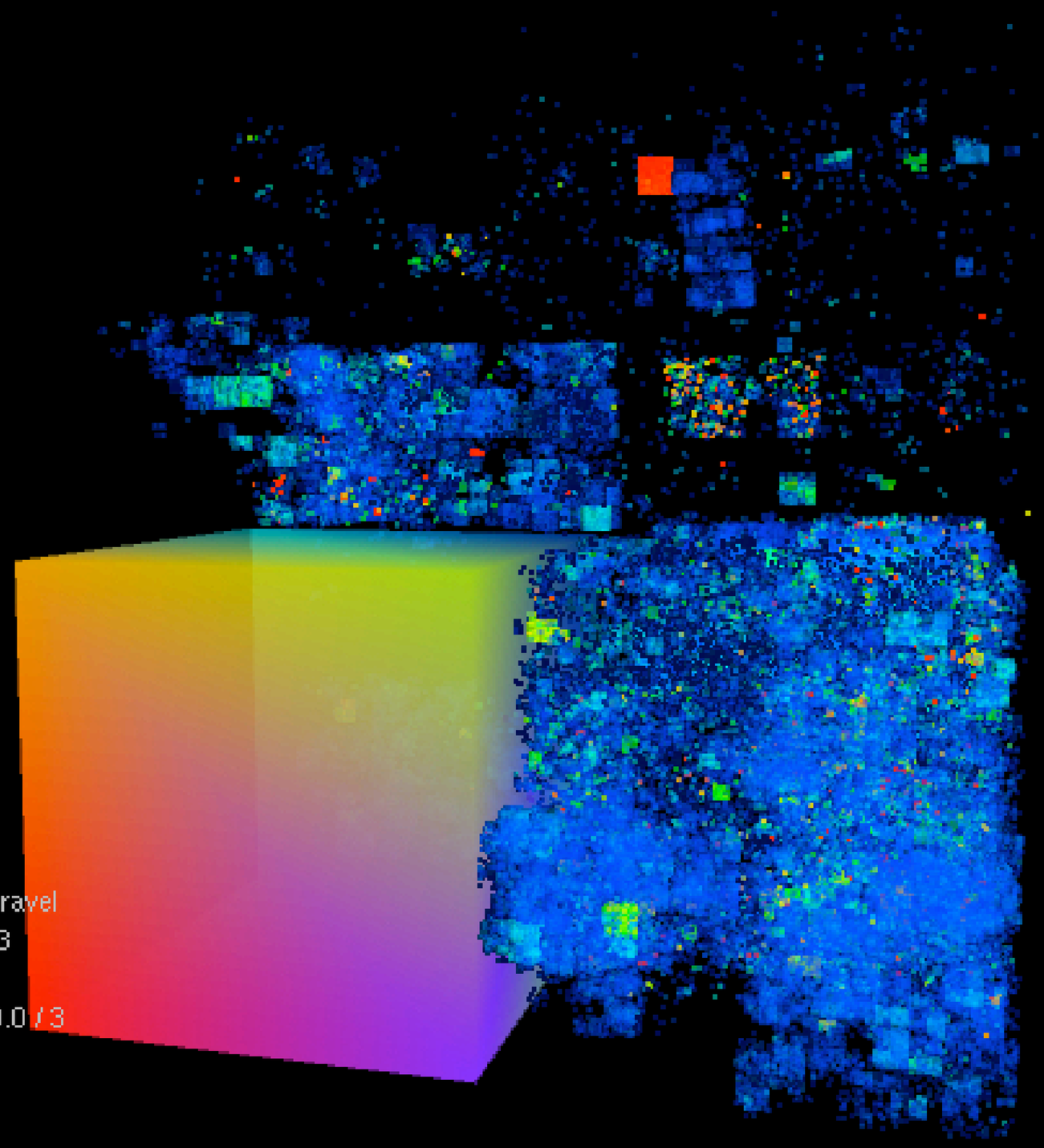
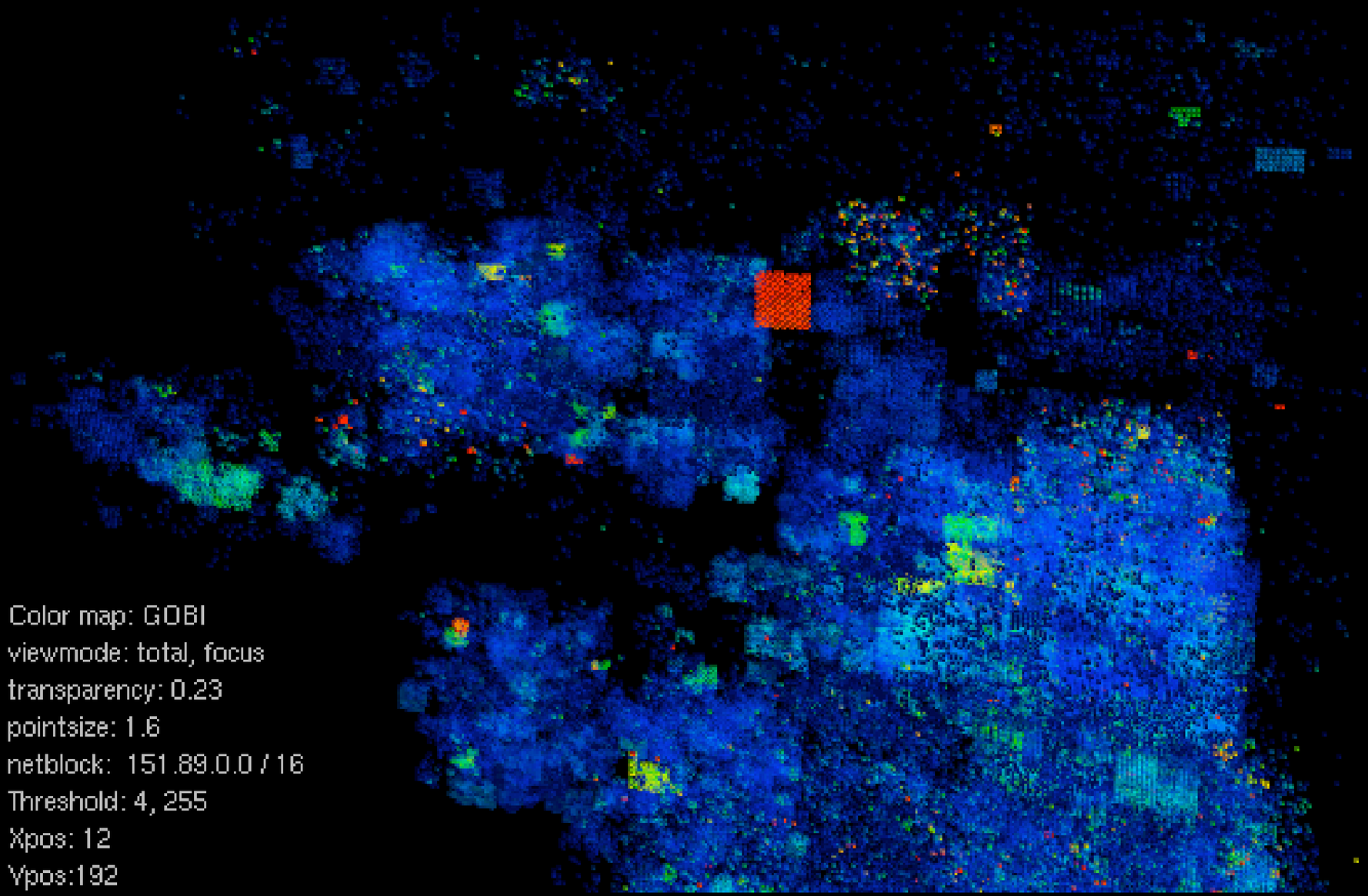
viewmode: total, travel
transparency: 0.23
pointsize: 2.5
netblock: 127.0.0.0 / 8
Threshold: 8, 255
Xpos: 27
Ypos:141

3D IPv4 Heatmap / Nominet UK



Color map: GOBI
viewmode: total, travel
transparency: 0.23
pointsize: 2.5
netblock: 224.0.0.0 / 3
Threshold: 8, 255
Xpos: 3
Ypos:192

3D IPv4 Heatmap / Nominet UK

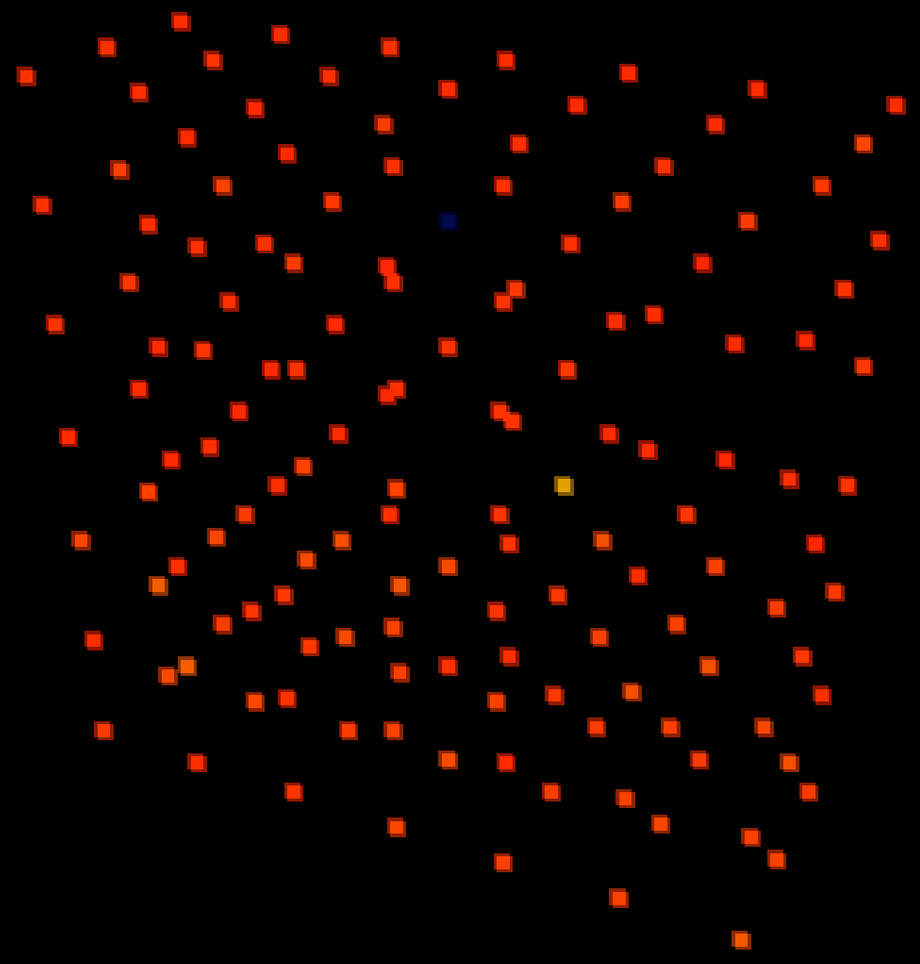


Color map: GOBI
viewmode: total, focus
transparency: 0.23
pointsize: 1.6
netblock: 151.89.0.0 / 16
Threshold: 4, 255
Xpos: 12
Ypos:192

3D IPv4 Heatmap / Nominet UK

Color map: GOBI
viewmode: cube, focus
transparency: 0.23
pointsize: 1.6
netblock: 151.89.0.0 / 16
Threshold: 4, 255
Xpos: 12
Ypos:192

3D IPv4 Heatmap / Nominet UK



Color map: GOBI
viewmode: cube, focus
transparency: 0.23
pointsize: 4.8
netblock: 151.89.0.0 / 16
Threshold: 4, 255
Xpos: 27
Ypos:204

3D IPv4 Heatmap / Nominet UK

Thanks to
Duane Wessels
&
John Kristoff

Color map: GOBI
viewmode: cube, focus
transparency: 0.23
pointsize: 4.8
netblock: 151.89.0.0 / 16
Threshold: 4, 255
Xpos: 27
Ypos:204

3D IPv4 Heatmap / Nominet UK

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viewmode: cube, focus
transparency: 0.23
pointsize: 4.8
netblock: 151.89.0.0 / 16
Threshold: 4, 255
Xpos: 27
Ypos:204

Questions?